Simulation-Based Evaluation for the Dismantling Scenario of the Reactor Vessel at Kori Unit 1

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1. Introduction

Dismantling of nuclear facilities takes considerable time and costs, so predicting how much time and budget is needed is an important concern in the preparing phase. After the government announced the shutdown of Kori Unit 1, existing methodologies based on prior data were attempted to estimate costs for dismantling of Kori Unit 1. These methodologies using prior data are very useful for obtaining approximate values but is not sufficient for planning the dismantling scenario that requires delicate analysis.

This paper proposes a simulation-based evaluation for the dismantling scenario of the reactor vessel at Kori Unit 1. This evaluation results time and costs for the dismantling scenario presented in this paper, and is useful for planning the dismantling scenario because the evaluation result is coordinated with the dismantling scenario.

2. Assessment system

The assessment system used in this paper consists of a process simulation module and a process evaluation module, and was originally developed by Decontamination and Decommissioning Research Division of Korea Atomic Energy Research Institute.

2.1 Process simulation module

The process simulation module basically simulates a dismantling scenario based on a commercial digital manufacturing platform, and simulates cutting processes included in the dismantling scenario using the function developed by Hyun et al., 2017 [1].

2.2 Process evaluation module

The process evaluation module evaluates the dismantling scenario based on Process Product Resource (PPR) tree structure, which is a data structure of the previously mentioned commercial digital manufacturing platform. The evaluated time consists of process cycle times and maintenance time, and the evaluated cost consists of initial costs, process costs, and maintenance costs.

3. Dismantling scenario

The target of the dismantling scenario is a reactor vessel of Kori Unit 1. The representative variables determining the dismantling scenario are the radioactive waste container, the remote dismantling system, and the segmentation plan.

3.1 Radioactive waste container

The radioactive waste container is selected as a Half Height ISO (HHISO), which is proposed by Lee et al., 2016 [2]. HHISO is a radioactive waste container capable of land transportation with a 20 ton truck, allowing efficient transport and storage of Low Level Waste (LLW) and Very Low Level Waste (VLLW). According to a recent conference paper published by KHNP [3], the reactor vessel is expected to be a low level, so segmented pieces of the reactor vessel can be stored in HHISO. In addition, low level radioactive waste can be accommodated in the shallow land disposal of the radioactive waste management facility operated by KORAD, so segmented pieces of the reactor vessel can be stored in HHISO for both transport and storage.

3.2 Remote dismantling system

The remote dismantling system is selected as a seamless remote dismantling system, which proposed by Hyun et al., 2014 [4]. The originality of the

dismantling system is in its ability to handle all the processes involved in the dismantling of major components of a nuclear power plant. The seamless remote dismantling system consists of a circular saw, gantry manipulator, waste container, band saw, and turn table.

3.3 Segmentation plan

The reactor vessel will be segmented into 37 pieces, and the segmented pieces will be stored in five HHISO containers as shown on Fig. 1. Since final states of HHISO containers is over 20 tons, segmented pieces should be stored in the HHISO container so that the weight of the container does not exceed 20 tons at transportation. Thereafter, HHISO containers are rearranged to final states.

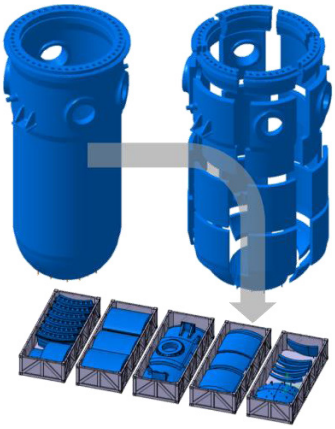

Fig. 1. Segmentation Plan.

4. Process simulation and evaluation

The dismantling scenario is simulated as shown on Fig. 2 using the developed process simulation module, and the evaluation result is shown on Table 1.

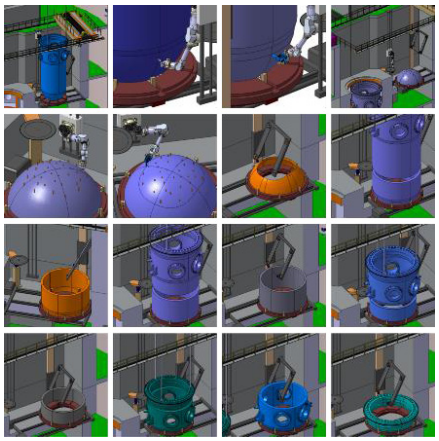

Fig. 2. Dismantling process simulation.

Table 1. Evaluation result for dismantling scenario

Items		Values
Total Time [Hour]	Process	149.3
	Maintenance	10
Total Cost [Million Won]	Initial Cost	1,693
	Process Cost	10.14
	Maintenance Cost	3
	Waste Disposal	6,100

5. Conclusion

The presented result can be regarded as the first attempt of the simulation-based evaluation in the field of the nuclear facility dismantling, although the values themselves vary according to input constants. These attempts are expected to contribute significantly to improved dismantling scenarios

Acknowledgements

The research was supported by the Nuclear R&D Program through the Ministry of Science, ICT & Future Planning.

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